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ABSTRACT

The problem of this research was to construct a list of behaviorally specifiable objectives for secondary school teachers to use in teaching the higher cognitive skills (ie., problem solving, rational thinking, and discovery) as well as subject matter. Process, as contrasted with content, was the focus. The specific Thought Process Objectives are delineated: (1) Assimilation; (2) Process; (3) Differentiation; and (4) Integration. The data, based on a nine week period, supports the conclusion that if a structure is provided for teachers that outlines what man does in the process of thinking, they will be able to teach these processes directly and purposefully, rather than incidentally. The difficulties encountered in selecting a Thought Process Objective and then writing a learning activity based on it are discussed, as are recommendations and implications of the study. (TL)

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"The Development of Cognitive Performance Criteria for Use by Secondary School Teachers"

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September 28, 1970

U.S. DEPARTMENT OF
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"The Development of Cognitive Behavioral Objectives for Use by Secondary School Teachers"

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September 28, 1970

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CHAPTER I

INTRODUCTION

Background

Educators and laymen mutually agree that the schools should continue to seek out the means by which they can teach youth the higher mental or cognitive skills. These skills are usually referred to vaguely as problem solving, critical or rational thinking, inquiry or discovery. There has been a greater emphasis in teaching the higher thought processes in the past decade but there still appears to be an imbalance weighed toward teaching memorization of facts. The proposed research described herein has been derived on the premise that the cognitive skills which are more complex than recall generally appear to teachers as a nebulous, undefined, infinitely vast and unstructured set of abstractions, whereas the content is understood as finite and easy to associate with the student's present status of achievement. Thus, the content often provides the only aspect of education that teachers can apply their talents to with security.

Problem and Purpose

The problem of this research was to construct a list of objectives stated as specific behaviors that secondary teachers can use in teaching the higher cognitive skills along with the content of the subject.

Methods

The development of this list was brought about in the following phases:

1. The research director spent the period from June 16, 1969 to August 16, 1969 reviewing the literature related to the cognitive processes higher than recall and from this study developed an early draft of the Thought Process Objectives.

2. The research director sent a copy of this list with an explanation to the eight secondary teachers serving as consultants who made a study of the list. After meetings with the consultants, the research director rewrote the list.

3. The consultants engaged in a series of trial periods during which they used the list in their classes and met to discuss problems in its use.

4. The teachers ran a special evaluation trial for nine weeks in the spring during which the teachers used the Thought Process Objectives in their classes and kept a running log based on four criteria:

Criterion 1
Can the Thought Process Objectives be related to the content of the course by writing the objective in terms of the content being taught?

Criterion 2
Can an activity be planned that gives the student experience or practice in the process of the objective?

Criterion 3
Can the student's achievement of the Thought Process Objectives be evaluated?

Criterion 4
Are the students able to achieve the objective?

Findings

The teachers' study of the list before using it resulted in some changes in it, and further changes were made after they used it in early trials.

The final evaluation conducted by the teachers showed that all of the objectives were used during the nine week period, evaluation criteria one and two were generally met well during this usage, but criteria three and four were less satisfactorily met. It was reasoned that we as teachers are still primarily subject matter or content oriented and that the students are still evaluated on this basis even though we may be attempting to teach process.

The teachers, after using the list most of the year, made the following comments. First, that they believe there is a need to put a greater emphasis on the teaching of thought processes. Second, this list aids the teacher in verbalizing the processes, thus facilitating the teaching of them. Third, the list as modified seems to adequately cover the higher cognitive processes.

The final draft resulting from the study is given below:

Thought Process Objectives

I. Assimilation (collecting information). Observes present environment and memory.

A. Makes observations using all possible resources.

1. Observes the facts about material things with all the appropriate senses.
a. Eyes - observes color, illumination, shape, texture, relative placement, and movement.

b. Ears - observes the quality of sounds: pitch, harmony, rhythm intensity, direction, and the continuance or intermittence of the sound.
c. Nose - observes the odors.
d. Tongue - observes the tastes.
e. Sense of Touch - observes shape, texture, hardness, temperature, and placement.

B. Observes the interrelatedness of facts in terms of time and space.

C. Observes the changes which occur in the facts when tested and treated by time or other treatments.

D. Views only the facts as observations. When observing does not consider his assumptions or inferences as observations.

II. Process.

A. Retains important and discards the unimportant facts.

B. Keeps facts objective and does not mentally alter them with his own pre-conception, bias or emotion.

C. Is able to note which aspects of communications by others are facts and which are opinions, assumptions, hypothesis.

D. Records data in some form when appropriate.

E. Restructures any communication. Converts from one form to another form and retains the original meaning.

III. Differentiation.

A. Notes differences and likenesses in things, concepts or ideas.

B. Orders things, concepts, ideas according to some criteria such as size, shape, priority and complexity.

C. Sorts according to likenesses and differences, using a have and have not dichotomous system.

IV. Integration.

A. Determines trends in data and predicts behaviors and phenomena on the basis of past observed occurrances in similar circumstances.

B. Accepts something as a cause of another thing only after having more evidence than the mere fact that the one occurs before the other.

C. Uses the knowledge of IB and IC when put together as a principle, proportioned relationship or formula to obtain a quantitative result.

D. Suggests to himself a wide variety of solutions.

E. Makes a final conclusion only after having enough evidence to:

1. Test it mentally.

2. Test it by trial, if appropriate.

F. Persists in findings when they have been carefully checked, even though they are unpopular.

Conclusions and Recommendations

The data produced by the teachers in using the Thought Process Objectives supports the conclusion that if a structure is provided for the teachers that outlines what man does in the process of thinking, the teacher will be able to teach these processes directly and purposefully rather than incidentally.

But the study also brought another factor to attention which would appear to affect both the data and suggestions for further study. The researcher had noted that the teachers were having some difficulty in choosing one or two Thought Process Objectives and building a lesson based on content and then after the lesson was written, determine which Thought Process Objectives were included.

This writer, even though he is convinced of the need for the structure given by the Thought Process Objectives and derived on the list, found that he also was not able to choose a Thought Process Objective first and then write a learning activity that was based on the objective.

It can only be concluded that we have been so conditioned to learning and teaching with a subject matter content orientation that we are unable to retool our thinking to adopt a system of teaching that would seem to far advance the results of the teaching.

This researcher would conclude with two recommendations regarding further research on this subject. First, it is hoped that other individuals would develop structures for thought processes which are done independently of this one. Second, it was learned in this study that teachers involved in using this list need more time in understanding and accepting it. Thus, he recommends that a study involving more teachers be undertaken in which the teachers be taught the concept of the Thought Process Objectives and the objectives themselves for three months prior to its use. Also, it is important that they are visited by a research director often and that they visit each other's classes frequently. Finally, the teachers trying the objectives should spend two or three months after the year trial revising the list and writing sample lessons and tests.

It is more than reasonable that at least some of the unrest in the secondary schools is stimulated by students holding their teachers accountable for what is being taught. Many students feel that they are being channeled into a single way of being by obedience to old truths and regulations rather than being prepared to creatively find new answers to old questions.

The old security of teaching the facts of a textbook is thankfully becoming less secure, but teachers need help in retooling their own minds so that they can guide their young charges to become divergent and self respecting, creative thinkers. This help can come in the form of a structure that defines divergent thinking in the language of the teacher. It is for this reason that this writer believes that the study of the creation and use of Thought Process Objectives must continue.

CHAPTER II

BACKGROUND FOR THE STUDY

In 1953 the Central Policies Commission of the NEA stated in a bulletin titled The Central Purpose of Education that the "common thrust of education is the development of the ability to think. . . . But this particular objective will not be generally attained unless the school focuses on it."

Since that time a number of worthy efforts have been put forth to aid the schools in realizing this objective. One of the most noteworthy is the writing of the Taxonomy of Educational Objectives by Benjamin Bloom[1] amd a Committee of College Examiners in 1956. They wrote a classification taxonomy of the cognitive objectives which includes the higher mental processes as well as simple recall. Bloom's hierarchy of cognitive mental processes is similar to the rational powers of recalling, imagining, classifying, generalizing, comparing, evaluating, analyzing, synthesizing, deducing and inferring which were recommended by the Central Policies Commission, but uses only six major categories and defines them much more clearly and precisely.

Also, since that time, J. P. Guilford[2] has developed that which he refers to as the structure of the intellect. He has divided the intellect into 120 exclusive theoretical factors. Of the 120 factors, 82 had been demonstrated when he explained his model in the book, The Nature of Human Intelligence, in 1967.

Jerome Bruner[3] writes in The Process of Education that it was generally agreed at the Woodshole Conference, which took place in 1959, that school curricula were fact bound. The schools were teaching science and other courses as a set of facts and principles to be memorized. This conference prompted the writing of new science and math curricula for the schools which emphasize the pursuance of objectives that are often referred to as inquiry or discovery objectives. Since that time new curricula have also been written in the areas of social sciences and language arts which tend to emphasize cognitive skills that are at a higher mental level than simple recall.

Furthermore, teacher education institutions have attempted to show new candidates to the profession the need for considering teaching goals which give students practice in the thinking processes. It is also rather common to include practice in writing objectives as specific behavioral objectives as defined by Robert Mager[4] in Preparing Instructional Objectives in 1962.

As a result of the work of the theorists and of the new curriculum writers and also of the teacher education institutions, we have begun to make some changes in the emphasis placed on facts and on higher cognitive processes. Whereas we have emphasized only facts in the past, we are now attempting to teach facts in such a way that they become the vehicle for teaching mental skills.

An imbalance of another kind, though related to facts vs. mental or thinking skills, continues to exist. Teachers generally can think of the content of a course, i.e., the facts, principles, and concepts of a course as a rather finite and specific body of knowledge. The language of this content is generally standard and mutually communicable among the experts in each of the subject matter areas; but the higher level thought objectives, on the other hand, have no commonly understood and accepted language to use for communication purposes among its users. This is understandable.

First, Guilford's work is very theoretical. In researching in this relative virgin area it was necessary for him to use terms which he had to define for his purpose. The structure of the intellect which he is developing is being described for the first time in this way and it is difficult to always relate it to particular specific behaviors of the actual living and behaving human being. Furthermore, many specific acts of the higher mental processes that should be taught are very likely complicated combinations of Guilford's separate factors and thus, are not readily identifiable in using Guilford's terms.

Bloom's work is less theoretical and it is likely that his classification could provide a more direct service to the needs as expressed by the Educational Policies Commission. Yet its present form does not provide teachers with the specific objectives that they should teach in order to cause their students to develop proficiency in the higher cognitive processes.

In looking again at the new curricula one can say that those teachers who are using them are able to make greater progress in teaching the higher cognitive skills than in the past. Yet the new curricula generally only provide the activities which give practice in these cognitive skills and usually the specific behavior that the activity is to bring about in the students is not spelled out. The teachers often have to teach the lesson with only the assurance of the textbook writers that some organized higher level objectives are being met. If stated at all, the objectives may appear as general statements, e.g., the analysis of data or the synthesis of data. The teacher can best teach a behavior if he can first state it verbally in such a way that he knows what a person <u>does</u> when he has learned it. There are a number of specific behaviors that a person does when he analyzes data or synthesizes data that are far from obvious in these short phrases. The teachers will be able to do better at teaching analysis and synthesis if they are able to verbalize these specific behaviors.

Thus, though the mental process theorists and the new curricula writers have aided us in moving toward the goal of providing students with the specific thought processes that enable them to use fact, there are further steps to take.

If the teachers are to increase their emphasis upon the teaching of cognitive skills, then they need to be provided a list of these skills written in terms of behaviors. At the present, the cognitive skills appear to teachers as nebulous, undefined, infinitely vast and unstructured

sets of abstractions with labels such as critical thinking, problem solving, creativity, etc. The present taxonomies are not written in terms that are meaningful to teachers and so there is an understandably strong tendency for teachers to apply their talents almost exclusively toward the apparently more secure facts.

Therefore, the problem of this research was to construct a list of objectives stated as specific behaviors that secondary teachers can use in teaching the higher cognitive skills along with the content of the subject.

CHAPTER III

METHODS

The development of the final list was brought about in the following phases:

1. The research director spent the period from June 16, 1969 to August 16, 1969 reviewing the literature related to the cognitive processes higher than recall and from the study developing an early draft of the Thought Process Objectives which appeared to this writer to have the following characteristics:
   a. They represented the processes that any individual must exhibit in solving a problem and were written in behavioral terms.
   b. They did not involve concepts that would be new to secondary teachers and thus, would be easily interpretable into their own words and into their pupils' behaviors.
   c. They were hierarchial in nature, i.e., generally one must do the earlier ones in solving problems before those later in the list.

2. The research director sent a copy of this list and an explanation of it to the eight secondary teachers who served as consultants of the study requesting them to determine what they felt would be difficulties. These teachers were selected from a group recommended by their principals and came from four high schools of this area. Following meeting with the consultants, the research director rewrote the list in an attempt to correct the deficiencies noted on the consultants first observations.

3. The research director began a series of trial periods during which the teachers tried the list out in their classes. During these trial periods the consultants met for the purpose of discovering their successes and failures in the use of the list. The primary purpose of these trials was to cause the consultants to become well versed in the nature of the list and comfortable in the use of it before they began the evaluation period. The research director also made visits to each of the consultants in their schools. The consultants kept a running log of all the trial periods using the guide shown below:

Guide for Research Log

General

Each consultant is asked to teach one class each day in which he uses the Thought Process Objectives for the first trial period.

It is extremely important to the success of the research project that the director have good communication with each of the research consultants during the time that they are using the

Thought Process Objectives in their classes. One method of facilitating this communication will be the writing of a summary of each lesson taught in the trial period which describes the Thought Process Objectives used, the nature of the activity of the class, the relationship of the objectives to the activity and a brief evaluation comment.

I. Thought Process Objectives.

Write the objectives of the lesson which you feel are process objectives in the words of the content of your course. Indicate by Roman numeral and letter after each of the objectives which Thought Process Objective your objective is by writing the Roman numeral and letter after it.

Example: Given a number of pictures select those which use formal balance (II-A).

II. Briefly describe the nature of the class activity. This can generally be done in a short paragraph.

III. Write a short statement that explains how the objectives you wrote in I are happening in II. This may be incorporated in the writing of II, but it is a very important step and must be considered by you in the planning.

IV. Evaluate.

The primary task here is to write a short statement which indicates the success you had in actually witnessing behaviors among the students which indicated they were doing the processes indicated by the objectives you wrote.

4. The evaluation trial was conducted for nine weeks toward the end of the school year. In preparing the consultants for this assignment they were asked to:
   a. Use the Thought Process Objectives in their teaching in such a way that one or two of the objectives would be emphasized per day or per lesson.
   b. Keep a running log of the plans that indicate how the objectives were used. This log is the same as the log that they have been keeping up to this time.
   c. Keep a running log of the evaluation of the objectives based on criteria which follow below. This running log should be for their purposes so that they could write a final report concerning evaluation to be turned in at the end of May.

Using the Criteria

It would be hoped that they would be able to attempt to teach each of the objectives in the list in the evaluation period remaining. The ideal evaluation would occur by first considering the type of content

that they wish to teach and then choosing an activity and process objective (or two) which appears to be easily related to the content.

If the activities of the classes were planned in advance (because of a unipac, etc.) then they will not have the flexibility to bend the activity to match the process as easily as if they were planning the activity as they proceeded, but they were asked to attempt to stress that aspect of the activity that lends itself to one or more of the process objectives and then test the objective with the four criteria.

Criterion I - Can the objective be related to the content of the course?

This criterion can be tested by attempting to write the objective in terms of the content being taught. The question would have to be asked, for example, about objective I-A under Assimilation. Can the statement, "makes observations using all possible resources," be written in such a way that it's related to the subject matter that is being taught? This does not mean, of course, that the statement has to be related to the content being taught at any time, but is the content of the course such that there are times when a statement can be written that's related to the content of the course that, in effect, says the students are making observations using all possible resources, or the students are learning to make observations using all possible resources? One would assume that a teacher would be able to relate this objective to the content of the course a number of times during the year if the objective is a valid one.

Criterion II - Can an activity be planned that gives the students experience or practice in the process of the objective?

This criterion can be tested for by first attempting to determine this activity and second, by carrying it out with the class.

Criterion III - Can the objective be tested for?

The teacher determines if he can develop a situation to test the student's performance of the objective.

Criterion IV - Are the students able to achieve the objective?

The teacher can test this criterion by simply determining how many students are able to show that they have achieved the objective. If only a small minority of the students are able to achieve the objective, then the teacher may question the appropriateness of this objective for the students of this class. He may also attempt to teach it again using a different activity to test for it a second time. Some objectives may require that the students have more exposure to them than others.

CHAPTER IV

DERIVATION OF THE LIST OF THOUGHT PROCESS OBJECTIVES

Phase I - Study of the Literature - Draft I of the List

Background

As was indicated in the previous chapter, the list of Cognitive Behavioral Objectives evolved through a number of phases. For purposes of communication this list was referred to as the list of Thought Process Objectives in all communications with the eight consultants.

The researcher's study of the literature during the summer of 1969, the first phase of the research, caused him to see the need for such a list of thought process objectives more intensely in that life is a performance on a tightrope. Each human being wakes up every day to face the effort of maintaining his balance. He spends each minute, hour, day, his entire life, placing one foot ahead of the other to maintain this balance. An increase in unsatisfied needs and thus, unsolved problems can cause him to slip, waiver, grasp the air.

Time is the movement along the tight rope. The multitude of needs large and small that envelop his existance are represented by the need to keep his balance. In solving the problems presented by the needs his balance is maintained. The struggle of the rope continues until he slips and falls, until the problems, either physical or mental, become so great that he cannot solve them.

It is because problem-solving is the occupation of our lives that Dewey[5], sixty years ago, and Guilford[2] and Hollister[6] more recently, emphasized that the major role of schools today must be to teach the thought processes for problem solving to enable each person to make the most of his native ability. Dewey, Guilford and Hollister and many others speak with one voice in their concern that the schools are overemphasizing the storage of information to the point of excluding training and practice needed to develop competence and thus, confidence in the use of all thought processes beyond memory.

Thought Process Steps - Antecedents to Thought Process Objectives

Men are constantly trying to describe the thought processes but seldom is this description to our satisfaction. We are forced to separate them into rather arbitrary and artificial compartments for the purpose of communication. Unfortunately, the mind does not work in the simple pattern so limited by spoken and written symbols. Thus, the higher mental processes have remained rather nebulous, overlapping statements of steps that still have many gaps in between them. They are often times far too complex to be easily aligned and traced to the actual solution of the problem, as is Guilford's Structure of the Intellect, or they remain somewhat too general as Dewey's Steps for Thinking.

By incorporating Guilford's problem solving model and Dewey's steps for selective thinking one is able to describe in steps, though they may be artificially and arbitrarily separated, what the person does from the moment he is aware of a problem until he has tested the solution. The Thought Process Steps are derived here for the purpose of providing a theoretical basis to be used for the determination of the Thought Process Teaching Objectives later.

Step I - Awareness of a Problem

Dewey says that all the productive thinking, which he refers to as reflective thinking, stems from a person's awareness of a problem. In order to have any kind of productive or reflective thinking take place, a person must have a problem. He feels frustration as the result of an unfulfilled need. These problems occur in an individual's life continuously from waking to retiring, from birth to death. The range in this problem can vary from what to wear in the morning to the development of a scientific apparatus in an attempt to prove a hypothesis for a doctoral dissertation.

Step II - Evaluation of the Problem

In this step the individual attempts to develop further understanding of the problem and its implication. This is the first information seeking step, but the information he is seeking is primarily related to the problem itself and not as much to the exterior conditions surrounding the problem.

Step III - Information Gathering

He collects information which is external to the question of the problem itself but information that would aid in tying the problem to the solution. In this step, there is a kind of a filtering that takes place according to Guilford. He makes rapid analysis of some information and then practically ignores it on sensing it because it may appear to him to be not of assistance in solving the problem, whereas he accepts other information and retains and remembers it.

Step IV - Relating Parts

He relates some parts of the information to other parts. He begins to see the interdependence of the facts.

Step V - Solution Suggesting

The individual derives suggested solutions. He permits a rapid flow of many possible solutions or subsolutions to come to his consciousness. He is able to consider <u>all</u> possibilities.

Step VI - Mental Solution Testing

He checks these solutions against the facts. In other words, he mentally tests the suggestions to determine whether they seem reasonable on the basis of the facts he already collected about the problem. In this step, he probably would begin to see one suggested solution as possibly standing out, i.e., passing these tests more favorably than others.

Step VII - Further Information Gathering

He looks for further facts that inferred solutions bring to mind. As his mind sorts through the possible solutions, the possibilities cause him to ask further questions about the conditions, thus causing him to look for and hopefully find more facts.

Step VIII - Establishing New Solutions or Altering Solutions

The facts found after the search of Step VII may cause him to alter the solution or completely replace it for a new one.

Step IX - Testing of the Suggested Solution

In this step, one would try out the solution to see if it does away with the problem and thus, the frustration. In some instances, this testing would be the mere mental process of going back and being absolutely sure that the solution would align with the facts and have the proper relationship with the facts. In other instances, it may be possible to test it physically by carrying out a trial run.

Analysis of the Steps

The steps could no doubt be analyzed and classified in many ways. Researchers though, often classify what we do mentally into the three categories of assimilation, differentiation, and integration.

Thought Process Steps two and three are steps of information gathering or assimilation. In step four the individual begins to differentiate by noting likenesses and differences, and thus, notes relationships. Integration begins with step five. He puts bits of information together to develop formulas, cause and effect relationships, predictions, and so forth. Integration continues with step six as he tests solutions.

Step seven suggests that further assimilation be carried out. After he determines the most favorable solution in step six he is able to look more specifically for certain kinds of facts (step seven), which in turn cause new possible solutions to be suggested (step eight). Therefore, step eight is a step of integration for the same reason given for step five.

In step nine he rechecks the rationality of the relationships of the facts to the problem and the suggested solution to be sure that it is reasonable. In doing this he is going back over the integrating process.

As one goes through the thought processes he is reminded again that the procedure that one follows in his thinking is not the neat package that the symbols of human language would demand of it. One's mind does not go through this process by steps but yet we are forced to write it down as steps in order to comprehend it. Furthermore, these steps may not be carried out in order. In some problems, certainly some step may be omitted and in other problems, some of the steps may be cycled back over and over again, until eight is arrived at. Or even when eight is reached, it may be cycled back over and over again because of the need for re-examination of the whole problem to check to see if a better solution may be found rather than impulsively accept an early insight.

The Derived List of Thought Process Objectives

In combining Dewey's and Guilford's work to build the Thought Process Steps for problem solving one can begin to symbolize and therefore, communicate what he does when he solves problems, but this still is not in the language that is useful to the teacher. The teacher who is interested in developing the student's ability to use the higher thought processes to solve problems needs to know what behaviors are actually manifested by the carrying out of these steps. Once the behaviors are determined then the teacher has a list of objectives which will be useful to strive for in teaching. Statements written as behaviors give the teacher something definite to zero in on in planning a teaching activity. Also, the behaviors are readily observable so that the teacher can recognize when they are occurring.

The objectives were derived directly from the Thought Process Steps shown above and are based on the three basic processes of assimilation, differentiation and integration. Many researchers' and teachers' works were traced through to determine what behaviors are manifested. One of these will be used to aid in explaining the list of behavioral objectives. The Thought Process Objectives are shown below:

Thought Process Objectives

I. Assimilation (collecting information), Observes present environment and memory.

   A. Makes observations using all possible resources.

      1. Observes the facts about material things with all the appropriate senses.
         a. Eyes - observes color, illumination, shape, texture, relative placement, and movement.
         b. Ears - observes the quality of sounds: pitch, harmony, rhythm intensity, direction, and the continuance or intermittence of the sound.
         c. Nose - observes the odors.
         d. Tongue - observes the tastes.
         e. Sense of Touch - observes shape, texture, hardness, temperature, and placement.

B. Observes the interrelatedness of facts in terms of time and space.

C. Observes the changes which occur in the facts when tested and treated by time or other treatments.

D. Retains important and discards the unimportant facts.

E. Keeps observations as facts, i.e., separates facts from opinion, assumptions, hypotheses or inferences.

F. Keeps facts objective and does not mentally alter them with pre-conception, bias or emotion.

G. Records data in some form when appropriate.

H. Restructures any communication. Converts from one form to another form and retains the original meaning.

II. Differentiation.

A. Notes differences and likenesses in things, concepts or ideas.

B. Orders things, concepts, ideas according to some criteria such as size, shape, priority and complexity.

C. Sorts according to likenesses and differences using a have and have not dichotomous system.

III. Integration

A. Determines trends in data and predicts behaviors and phenomena on the basis of past observed occurrences in similar circumstances.

B. Accepts something as a cause of another thing only after having more evidence than the mere fact that the one occurs before the other.

C. Suggests to himself a wide variety of solutions.

D. Makes a final conclusion only after having enough evidence to:

1. Test it mentally, and

2. Test it by trial, if appropriate.

E. Persists in findings when they have been carefully checked even though they are unpopular.

It was my intention to make the list all inclusive for cognitive processes. Behaviors related to higher Cognitive Thought Processes should fit under one of the objectives. Thus, the list could serve as a classification system.

But it is more important that we think of the list as an inclusive list that will remind a teacher of the various kinds of objectives that he can write in any subject when he wishes to focus on teaching that goes beyond simply learning facts, principles, and ideas.

Furthermore, all of the objectives are written in general form, i.e., are not associated with any one kind of subject matter. Of course, this is as it should be for the behaviors related to thinking or problem solving steps should be equally related to any and all content. Each of the objectives can be rewritten in the words of any particular content at any time. Examples of how this is done are given later in this report in the section demonstrating their use.

Further Explanation of the Thought Process Objectives

I. Assimilation. Observes Present Environment and Memory.

Assimilation is thought of here as the behaviors that one should have in order to be able to adequately collect information for the purpose of solving a problem. (It is probably unnecessary to remind the reader that there is no other reason to collect information.) Assimilation is further divided into two separate areas of endeavor for information is made available for use on any problem by both observing and recalling from memory.

One finds the same kinds of observations whether he is observing his present environment or recalling past experiences. He may observe facts in the present environment by using the five senses and he may observe facts and principles (which show the relationship between facts) as the present environment by reading and listening. He may also observe facts and principles by way of memory. Consider the female college student waking up in the morning in the dorm with the problem of deciding what to wear. She can recall what is in the closet and available (fact) and she can recall the relationship between wool and heat transfer (principle). These same observations could be made in her present environment.

I-A. Makes Observations Using All Possible Resources.

This is best understood by relating it to a sample problem. Consider again the problem above of the girl deciding what to wear. She would be exhibiting this behavior of using all possible resources satisfactorily if she uses all possible sources of information. She may lie in bed and recall what is in the closet, what type of clothing is appropriate for the kinds of weather or for what she intends to do that morning or for what fits the existing fad. She also goes to the closet and looks for facts as well as to look out the window for facts about the weather or what the others are wearing. If she leaves out any of these sources of information, she would be inadequately demonstrating the behavior of using all possible resources and as a result be more susceptible to making an unsatisfactory solution to her problem.

People appear to have a tendency to observe with one sense and ignore others. Also, they often overlook some of the qualities suggested in the list associated with each sense. The girl opens the closet and sees shapes and colors which tell her what clothes are available. At the window she sees a gray sky, barren and bent trees, the attire of other students. She hears whistling sound varying in pitch. On opening the window she feels the coldness on her face. She puts her hand out and feels the light rain.

I-B. Observes the interrelatedness of facts in terms of time and space.

Not only do we observe facts but we observe how individual facts are interrelated to one another in terms of time and space. The girl observed in the past and now recalls from memory that whenever the wind blows the students wear a certain style of windbreaker, i.e., she observes in her memory a relating of two facts. She also observes that it is Tuesday and that on Tuesday she has no classes, a relationship of two facts that may affect her final conclusion of what to wear.

I-C. Observes the changes which occur in the facts when tested and treated by time or other treatments.

An astute observer will note how facts change when affected by time or some other variable. She recalls that it usually warms up considerably by noon at this time of the year. She also observes when looking out the window thirty minutes after the first time that the rain is now pouring down instead of sprinkling as it was earlier.

I-D. Retains the important -- discards the unimportant. Retains only the facts.

When solving problems we quickly scan the facts and concentrate on those that are important, discarding those that appear unimportant. As teachers we know some students have difficulty in judging what is important to the solution of a particular problem and what is not. It is probably obvious to the girl while looking through the closet that some facts are unrelated to the problem and are not given another thought. These might range from the color of the furniture in the room to the record playing on the stereo.

I-E. Keeps observations as facts, i.e., separates facts from opinion, assumptions, hypotheses or inferences.

It is important for all observers to keep observations as objective fact. We do not observe that someone is angry, but rather we observe that his face is red, that he is shouting and shaking and then we infer that he is angry. When the girl looks

out the window and sees the street is wet in the most technical sense she does not observe that it is raining or has rained. Her inference may be an incorrect one. It's possible that the streets were watered by the city street watering equipment. An observation is only a description of the facts that a person obtains by use of the five senses, but does not include any thought or statement about cause or implication of the facts.

I-F. Keeps facts objective and does not mentally alter them with preconception, bias or emotion.

Assume that the girl has purchased a very light warm weather outfit the evening before. She looks outside and instead of observing objectively that the sky is dark, the trees are barren and bent, the other students are wearing heavy clothing, she "observes" that it is the fifteenth of August and the weather "isn't so bad." She does not want to believe the facts as they exist because of her bias caused by her desire to wear the new clothes. Observations are often distorted by preconception, bias and emotion which in turn have been spawned by ego involvement. When we keep outselves from observing things as they really are we often lose vital information needed for good problem solving.

I-G. Records data in some form when appropriate.

Some problems require the use of data that is so complex that it must be recorded in some form. All of us should have an opportunity to learn how to record data in a manner that is appropriate to the problem. To the secondary student this means everything from writing down assignments and taking notes to drawing sketches and making tables and graphs.

I-H. Restructures any communication. Converts from one form to another form and retains the original meaning.

Often it is necessary to transfer a written or spoken communication or datum from one form into another. A student may convert a table of rats' weights with certain diets to a graph. he may attempt to put in his own words or to act out what he thinks an author is trying to say in a poem, or a composer with a piece of music. He may write an equation in symbolic form to describe the relationships given in a short paragraph.

II. Differentiation.

After data is assimilated it is differentiated. In differentiating, we arrange the data into parcels or categories to give it an order so as to be useable. In the most direct form the end product of this might be thought of as classifying.

II-A. Notes Differences and Likenesses in Things, Concepts or Ideas.

Our yet pajama clad student has long noted the likenesses and differences in her closet relative to size, color, warmth, etc.

II-B. Orders Things, Concepts, Ideas According to Some Criteria such as Size, Shape, Priority, and Complexity.

Thus, she can carrange or order her clothes according to what extent each item is a certain size, color, designed for warmth, etc.

II-C. Sort According to Likenesses and Differences Using a Have and Have Not Dichotomous System.

Furthermore, she would probably be able to go a step beyond arranging her clothes in order according to some variable and develop the classification system and sort them according to this system. She could classify the items in her wardrobe according to season, type of activity, appropriate for method used to clean or by some other variable.

She obviously does not do the three behaviors in a very precise or elaborate way, yet it is done. If the items in her wardrobe were mentally clumped together as just a lot of clothes with no differentiation, her problem would be an impossible one.

She, of course, not only differentiates the clothes aspect of the data but other pertinent data as well. She notes differences in weather, activities, days of the week, etc. and builds a classification system of these which orders the data in something less than a conglomerate to give them meaning and make them readily available for use.

III. Integration.

Whereas, when we assimilate we collect data and when we differentiate we describe and categorize, when we integrate we determine relationships of data to data, and data to the problem to obtain a solution. Putting it another way, we attempt to see how all the pertinent facts and ideas are tied together by dependence or cause-effect relationships.

III-A. Determines Trends in Data and Predicts Behaviors and Phenomenon on the Basis of Past Observed Occurrences in Similar Circumstances.

After observing what clothes she has available and relating this to the weather data, our unclad student will make a prediction of the kind of clothing other students will wear. This prediction will be based on past observations she has made of students' attire for days which had similar weather to that of

this day. She also may be able to determine how the other students might react to various items of clothing that she wears.

III-B. Accepts Something as a Cause of Another Thing Only After Having More Evidence Than the Mere Fact That the One Occurs Before the Other.

Even though she is aware of the past pattern of clothing worn by other students for days with certain behavior and is able to make a prediction for clothes worn on that day, hopefully she will avoid moving too quickly to the inference that the weather is the cause of what other students wear. With even a small degree of sophistication, she will recognize that the weather is only one of many variables determining the college students' attire. Whatever is fashionable for the activity to be pursued is likely to have far more influence on attire than is the weather.

III-C. Suggests to Himself a Wide Variety of Solutions.

The good problem solver is able to cause a multitude of solutions to come to consciousness, unlimited by convention or regulation. He may weed out those suggestions which persist as disadvantageous because of their lack of convention, but at least he does not reject them before giving them some fleeting mental trial or test.

If our young college student is to be a creative dresser she must at least permit many varied possibilities to enter her mind. She even considers the thought of wearing her pajamas, or a formal, or new, brilliantly colored, bellbottom pants, or her skirt that needs shortening, or her swim suit, or a see-through blouse.

III-D. Makes a Final Conclusion Only After Having Enough Evidence to: Test it Mentally, and if Appropriate, Test it by Trial.

She begins to focus on the bellbottom pants and thus, tests the idea mentally by asking herself:

1. What will the other students think and say?
2. Will they be warm enough?
3. Will they be too different?

and thus, she tests this solution mentally before making a final decision that it is a good solution. In this circumstance, she can not test the solution by trial.

She may, of course, look for more data, (assimilate), once this solution begins to appear as the best by calling a friend and asking what she thinks, looking out the window to determine once again what the others are wearing and how the bellbottom pants will fit in, etc.

III-E. Persists in Findings When They Have Been Carefully Checked Even Though They Are Unpopular.

The person who is innovative in arriving at a solution is, of course, being different and by being different is open to the attacks of those from whom he is being different. He may prefer not to follow his inclination to use what may be the very best solution to a problem if he is criticized or even rejected by others. Of course, if all solutions are dictated only by what has proven to be acceptable, the possibility of there ever being anything new is completely eliminated. Hopefully, those who do discover new theories, procedures, philosophies, etc., will persist.

Using The Thought Process Objectives to Write A Lesson

There are two distinct ways that a teacher can write a days lesson to incorporate some of the Thought Process Objectives. Generally, the nature of the content that a teacher is working on with the students is determined by a course guideline or textbook. Thus, the first thing that a teacher does when preparing a lesson activity in either case is to pick a topic from the guideline or text.

What he does next is dependent on his ability to pick out certain Thought Process Objectives before writing the lesson and write the activity so that they are covered. If he is relatively unfamiliar with the Thought Process Objectives, he may find it convenient in the beginning to write the lesson in such a way that he knows some of the thought processes will be practiced by the students and then go back over the lesson after it is written to determine what specific ones are covered.

As he becomes more familiar with the list he may find that he will be able to pick out the specific thought processes that he wishes to teach before writing the lesson and thus, write the lesson in such a way so that he knows they are included. This method offers the thought processes that are emphasized over a given period of time.

Below is a lesson plan which was written by a ninth grade science teacher who knew that he wanted to teach the students that materials of some colors radiate more heat than others, but he was not certain at the time of writing the lesson what thought process objectives would come out of it. He wrote it in what he thought was a creative fashion with the intention of determining after it was written what the thought processes are that he was emphasizing.

Lesson - Radiation and Colors

1. Interest the students in the radiator in the room.

2. What could be done to make the room warmer?

3. What can be done with our tired radiator to make it warmer in here?

4. Does its color make any difference?

5. Does the color of an object make a difference in the heat absorbed by radiation?

6. Might this also be true of radiation?

7. How might we test the color-radiation relationship?

8. Students test hypothesis in various ways.

9. What answer does the data that you have suggest?

After having written the lesson the teacher will attempt to dry-lab it to determine what thought processes will be emphasized.

Dry-Labing the Lesson

I'll assume that I walk over to touch the radiator and say, "I noticed that some of you were sitting on the radiator before class began. Apparently, it isn't too hot. It is cool in this room, isn't it? What do you suppose we could do to make it warmer in here?" This is a general question, but I'm not expecting any answer, only trying to set up a problem that they will think of as their problem. I'll obviously get many attempts by the students to be humorous.

After that I'll continue with: "Let's assume though, that this is all we've got. We just have the room itself, and the same old, tired radiator that we have in here. Do you suppose anything could be done with the radiator itself in order to get more heat out of it?" Again, the question is general and the students' answers will be varied. By chance, one might mention by painting it. The radiator has a coat of aluminum paint, which is often the case in older schoolrooms. It's the old-style radiator.

If the students do not say anything about the color, then I might say, "Do you suppose what color a radiator is really makes any difference as to the amount of heat it gives off?" Again, the students' answers would be quite varied. I'm sure that some of them would say no. They think that there is just a certain amount of heat in the radiator and that the color of the paint wouldn't make much difference.

I'll continue, "Well, then you generally feel that the color of the paint on the radiator isn't going to make much difference as to how much it gives off. Have you ever had the experience of putting your hand on the outside of an automobile or your arm on the door when it was standing in hot sun and burning your arm, maybe not enough to damage the tissue, but enough to feel the pain?" Again, there would be answers given and some people might cite some particular circumstances.

Up to this point, I have been defining the problem and attempting to get them involved in the problem to the extent that they feel that it is "their" problem. Practice of the thought processes can be of value only if the students are working at the problem in a natural problem setting in that they are motivated to solve the problem because of their desire to find the answer. People cannot be forced to creatively find facts to the problem. This is a natural process which only comes about when people have a problem that they want to solve.

So I'll add, "A car that I was driving a few years back was white on the outside and had a black metal frame for the window on the inside. The sun, shining down on the window frame, had about equal exposure on the two colors. I put my arm out over the window while driving. Do you think there'd be any difference in what I'd feel when I touch the white versus the black?" Some of the students will have had the experience to answer the teacher's question correctly and probably would make the comment that the black car is always much hotter in the same amount of sunlight as the white car, or a black part of a car would be hotter than a white part of a car. I am attempting to stimulate them to recall or observe from memory facts that have some relationship to the problem. They would be beginning to practice observation of facts about material things with all appropriate senses. In this instance, it would be from memory. (I-A)

Furthermore, the students would observe the interrelatedness of the facts in noting that the white part of the car was less hot than the black part. This would be I B, and also the beginning of assimilation (II-A). "Well then, apparently the color of an object does make a difference as to how much heat it takes in by radiation and then gives back off to you when you touch it. Do you think this tells us something about the radiator?" Many of the students would begin to speculate that at least it's possible that the amount of absorption of heat is somewhat dependent upon color and that the giving off or radiation of heat might be dependent upon the color. This speculation is actually the first step of integration - determining phenomenon on the basis of past observed occurrences in similar circumstances (III-A).

Now I'll see if they can find ways to solve the problem, "Alright, you're suggesting, possibly even hypothesizing, that the amount of heat radiated by a material is dependent upon the color of the material, or at least, is one of the factors."

If the students haven't already said they could try to find out by painting half the radiator a very contrasting color to the other half, or make some other suggestion, then I'll ask the question, "If it is a possibility that color affects radiation how can we examine it further to determine if it's true or not?" The students might talk about testing the radiator. Some may suggest miniature radiators or testing devices of various kinds. I'll, of course, let them work at just simply conjuring up whatever kinds of apparatus they can, helping refine the ideas in

order to determine something which might actually be able to be tried with apparatus I have or that they can bring in.

I'll let them work on this problem in small groups if the interest is great enough. They can begin to describe in writing how they plan to test the hypothesis. I will attempt to guide them into the use of apparatus that is possible to use here. They can bring in materials if necessary and try them tomorrow. During this part of the class, the students are integrating (III-C). They should be suggesting a wide variety of solutions (ways of testing the hypothesis).

The teacher then writes the following objectives:

The Students Should Be Able To:

1. Observe facts about material things with all appropriate senses (from memory). (I-A)

2. Observe facts about material things with all appropriate senses (when observing whatever apparatus used to show that some colors radiate more heat than others. (I-A)

3. Observe the interrelatedness of facts. (I-B)

4. Record data in a form appropriate for apparatus used to test the radiation hypothesis. (I-G)

5. Determine that the possibility exists that the amount of heat radiation of an object is dependent upon color because of having seen that the amount of heat absorption of an object is dependent on color. (III-A)

6. Consider a wide variety of ways to test the best radiation hypothesis. (III-C)

7. Make a good conclusion based on facts observed from his apparatus. (III-D)

The teacher may not wish to stress all of the objectives listed above, yet they represent processes that are practiced in the lesson. Also, there are other objectives that the teacher may find that will occur incidentally or that he can make occur with only slight modification. The teacher may note that some students tend to retain the unimportant facts in such a way that those facts interfere with the conclusion. (I-D) Also, some of the students may not want to believe that color makes a difference in radiation, no matter how conclusive the evidence may be. (I-F)

A Sample Lesson From An English Class

Some, if not all English teachers think of the English course as a course in communications. Therefore, the teacher desires to provide an opportunity for the students to be able to communicate without misunderstanding or confusion to others. Of course, the reverse of this, perceiving communications of others with the meaning intended by the sender, is just as desirable.

The teacher has been impressed and hopes to equally excite his students by the awareness of the seemingly infinite ways that people can communicate. We can attempt to give a message to another person or a group of people with a silent film, a newspaper account, a short story, a drama performed on radio, a speech, a discussion, a debate and on and on through an endless array of modes and systems which are being broadened through the coming of each technological year.

The more ways that we are able to receive communications, of course, broadens our ability to assimilate. The more ways that we are able to put together various kinds of communications meant for others, directly corresponds to our ability to integrate.

It becomes obvious that learning the skills of how to send and how to receive communication and determining what to communicate involves all the steps of problem solving and cognitive thinking. An example of one Senior English classroom activity will demonstrate how it is related to the Thought Process Objectives.

Lesson - Interpreting Poetry

1. Students meet in groups of 4 - 6. Place at least one student in the group who has written poetry or even one poem.

2. The student poets of each group will have been informed earlier by the teacher to read all or part of the poem and then ask the other students to guess at what he was trying to say. He should listen, but stay out of the discussion.

3. After the other students have made educated guesses about the poem and the student poet has listened to the discussion, along with its disagreements, he should explain by paraphrasing what he meant to communicate in the poem.

4. Also, he should point out how certain meanings given to parts of the poem by other students, even though not exactly what he had in mind, were reasonably and logically worked out, thus showing flexibility in the interpretation.

5. This lesson would be followed up by an attempt by all students to write poems that they would interchange and study for the purpose of paraphrasing.

At least two of the Thought Process Objectives are being focused on in the lesson. The end product of explaining in one's own words what the intended meaning of a poem is, is Thought Process Objective I-H.

Other thought processes are carried out in this process. As the poem is being read, each of the students would attempt to associate the words and phrases of the poem with their own past experiences and thus, hopefully would be observing acutely from memory the perceptions that the words of the poem call for. This would give them practice in objective I-A.

It is hoped that each student would think of the process as a problem in which he not only must observe from memory, but that he must, if he is to be creative in the process, be able to allow many interpretations or solutions to come to mind no matter how wild before testing them. The teacher would desire to increase his flexibility by expanding his inflow of possible answers. This process is that of III-E.

* * *

Phase II - Consultants Review - Draft II of the List

The second draft of the list was produced following meetings with the consultants. During these meetings the researcher reiterated the purposes of the study and the goals that were being strived for as described in the research proposal. He then summarized the result of the preparatory study for the research, emphasizing the derivation of the objectives, their interpretation and their intended use. The consultants asked questions about the meaning of the Thought Process Objectives and their use which the researcher attempted to answer.

Prior to the meetings, the consultants had been asked to outline a lesson that they were teaching and to note which, if any, of the Thought Process Objectives fit the lesson. They were also asked to write down Thought Process Objectives which they discovered in the lesson that were not already on the derived list. The consultants, using these experiences, reacted to the list, making suggestions which caused the researcher to rewrite the Thought Process Objectives as shown below.

The major change is the inclusion of the additional category referred to as Process. The suggestions of the consultants as a group made it appear that some of the objectives are those in which the problem solver is processing individual facts as, or shortly after, they are perceived to prepare them for later differentiation and integration. Differentiation is in itself a type of process on the facts, but Process is distinguished from Differentiation in that each fact is operated on independently of others in the way described in the Process Objectives.

Whereas, under Differentiation observed facts are operated on in groups rather than individually and more definitely after they have been recorded, separated from bias and conjecture, etc.

Thought Process Objectives

I. Assimilation (collecting information). Observes present environment and memory.

   A. Makes observations using all possible resources.

      1. Observes the facts about material things with all the appropriate senses.
         a. Eyes - observes color, illumination, shape, texture, relative placement, and movement.
         b. Ears - observes the quality of sounds: pitch, harmony, rhythm intensity, direction, and the continuance or intermittence of the sound.
         c. Nose - observes the odors.
         d. Tongue - observes the tastes.
         e. Sense of Touch - observes shape, texture, hardness, temperature, and placement.

   B. Observes the interrelatedness of facts in terms of time and space.

   C. Observes the changes which occur in the facts when tested and treated by time or other treatments.

   D. Views only the facts as observations. When observing does not consider his assumptions or inferences as observations.

II. Process.

   A. Retains important and discards the unimportant facts.

   B. Keeps facts objective and does not mentally alter them with his own preconception, bias, or emotion.

   C. Is able to note which aspects of communications by others are facts and which are opinions, assumptions, hypotheses.

   D. Records data in some form when appropriate.

   E. Restructures any communication. Converts from one form to another form and retains the original meaning.

III. Differentiation.

   A. Notes differences and likenesses in things, concepts, or ideas.

   B. Orders things, concepts, ideas according to some criteria such as size, shape, priority and complexity.

C. Sorts according to likenesses and differences using a have and have not dichotomous system.

IV. Integration.

A. Determines trends in data and predicts behaviors and phenomena on the basis of past observed occurances in similar circumstances.

B. Accepts something as a cause of another thing only after having more evidence than the mere fact that the one occurs before the other.

C. Suggests to himself a wide variety of solutions.

D. Makes a final conclusion only after having enough evidence to:

1. Test it mentally, and

2. Test it by trial, if appropriate.

E. Persists in findings when they have been carefully checked even though they are unpopular.

* * *

Phase III - Trial Usage of Draft II of List II and Draft II of the List

As was indicated in Chapter II, the teachers used List II during the school year for the primary purpose of developing a thorough understanding of the list before the nine week evaluation period. The following table is taken from the logs of the teachers kept for a twelve week trial. It shows the number of times that each objective of the list was used by each teacher.

Table I

Number of Times Objective Used

Twelve Week Trial

Teacher		Soc.Sci. A	Art B	Math C	Biol. D	Math E	Chem. F	Engl. G	Engl. H
Objective									
I.	A.	3	2	3	1	6	2	12	3
	B.	3	2	3	2	4	0	6	0
	C.	1	0	2	0	2	0	6	3
	D.	1	0	10	1	2	1	1	2
II.	A.	11	6	5	6	0	2	4	5
	B.	2	2	7	2	0	0	5	2
	C.	0	0	6	3	0	1	9	4
	D.	39	2	2	0	1	2	4	2
	E.	4	3	8	4	2	2	6	5
III.	A.	20	11	8	4	3	3	2	2
	B.	14	9	1	0	1	2	6	1
	C.	0	3	5	0	2	2	1	1
IV.	A.	6	5	3	3	4	1	3	2
	B.	2	1	8	4	1	0	6	5
	C.	0	4	0	1	1	4	3	1
	D.	21	3	6	0	3	1	3	3
	E.	0	0	0	1	0	0	1	1

In examining this table one can first note that there is a wide variation among the teachers of the total number of objectives used for this trial period. This can be attributed to the extreme differences the eight teachers had in their approach to the development of a lesson. Some followed the system of teaching one lesson per class period. Others developed lessons that might cover several class meetings or even several weeks. Some developed lessons which were less teacher centered than others, and thus controlled fewer objectives which all students were striving to meet.

If one of the objectives had not been used or had been rarely used by the teachers as a group, one could suspect its validity and consider its exclusion from the list. As it turns out, this might be true of only one objective, IV-E. It was used once by three teachers. Objective IV-E is stated: persists in findings when they have been carefully checked, even though they are unpopular. Discussions with colleagues as well as the eight teachers causes this writer to believe that it has content validity. It would seem that a truly productive

citizen should tenaciously stay with his conclusions based on sound fact and rationality when they are threatened. This objective spills over into the affective domain in that it is probably related to ones confidence in himself as an original thinker.

As the teachers began the trial useage of the list of Thought Process Objectives, the research director asked the consultants to report evidence of thought processes that they could verbalize that were not on the list, as well as to determine those on the list that seemed to never be appropriate. The teachers brought to the meetings a concern that they could not find a Thought Process on the list that matched with the students' learning to use a quantitative statement such as an equation to obtain a result. It did appear that this process was one that was often a necessary step in a person's thinking while attempting to arrive at a conclusion.

Thus a new Thought Process was added to the list. It is stated as follows: uses the knowledge of I-B and I-C when put together as a principle, proportional relationship, or formula to obtain a quantitative result. It does appear to be an integrating process following IV-B, the process, accepting something as a cause of another thing only after having more evidence than the mere fact that the one occurs before the other, but tentatively, it was given the new position and symbol of IV-F so that it would not be confused with other objectives in the reporting of data.

* * *

Phase IV - Final Evaluation of Draft III
Derivation of Fianl List

The evaluation trial provided the last opportunity for data that could lead to the modification of the list of Thought Process Objectives in this research.

The data derived primarily from the teachers' reaction to the four criteria will be presented in table form and a statement will be written to explain what was given by each of the eight teachers.

Table II

Number of Times Objective Used

Evaluation Period

Teacher		Soc.Sci. A	Art B	Math C	Biol. D	Math E	Chem. F	Engl. G*	Engl. H
Objective									
I.	A.	0	4	0	1	6	3		4
	B.	1	3	0	1	4	0		0
	C.	1	0	0	0	1	5		1
	D.	0	3	0	1	0	1		0
II.	A.	0	3	12	2	3	1		0
	B.	0	3	0	2	4	1		2
	C.	0	0	0	0	3	2		2
	D.	6	1	0	1	0	4		4
	E.	0	0	34	0	14	0		2
III.	A.	3	4	0	1	14	0		1
	B.	2	5	1	1	6	1		0
	C.	0	6	1	0	5	0		1
IV.	A.	2	3	1	1	9	5		2
	B.	0	2	0	1	2	0		0
	C.	0	2	0	2	3	2		1
	D.	2	0	1	2	7	2		1
	E.	0	0	0	1	1	1		0
	F.	0	0	8	1	8	5		0

*See written explanation for Teacher G.

The four criteria that will be discussed in the following teacher summaries were stated in Chapter II and are as follows:

Criterion I - Can the Thought Process Objective be related to the content of the course by writing the objective in terms of the content being taught?

Criterion II - Can an activity be planned that gives the student experience or practice in the process of the objective?

Criterion III - Can the student's achievement of the Thought Process Objectives be evaluated?

Criterion IV - Are the students able to achieve the objective?

Teacher A - Social Science.

This teacher's log shows that he had used seven of the objectives during the evaluation period. Criteria one and two were satisfied. He indicated that he tested for the objective (Criterion III) by observing the students' behavior in performing in class and that they were able to meet the objective satisfactorily (Criterion IV). This is a rather subjective treatment of Criteria III and IV and does not provide, with any degree of certainity, that evaluation activities can be developed for the objective and how well the students performed.

Teacher B - Art.

During the evaluation period this teacher taught three separate lessons or units. Generally, all four criteria were met in lessons I and III. There was no difficulty in writing the objective (Criterion I) and developing an activity to teach it (Criterion 2). No written test was developed but the teacher did evaluate each of the students orally (Criterion III). He indicated that all students were able to meet the objectives (Criterion IV) but, in his own words, "Some sooner and with less help than others, or by choosing and doing a different activity to accomplish the same goals." He felt that he was generally unsuccessful with the second lesson and the objectives in it. He had not taught this lesson before and found in this first time that the students were not able to understand the relationships in the problem he set before them. He feels that he will be more successful in another attempt if he is more explicit with his directions and with the objectives.

Teacher C - Math.

This teacher evaluated the objectives using the criteria by making the following statements. "I attempted to write the performance objectives for the unipac in thought process form. The unipac was written first with objectives in behavioral terms. The behavioral objectives were then written in thought process form. (Criterion I and Criterion II)

"In most cases the students worked individually, and by satisfying the requirements of each objective and working suggested problems, were able to meet the requirements of the unit. Because the objectives were first written in behavioral terms there was no problem in evaluating the student. (Criterion III)

"The instructor's approach to teaching a particular unit will offset the frequency with which certain thought process objectives are used. If he approaches it from the concrete more of the objectives in Part I could be used. Approaching a unit more from the abstract would exclude many of the objectives in Part I, especially I-A. I can imagine situations where I-B and I-C could be used in a fictitious problem, but still seem to require a physical setting. The approach would depend on whatever premises the instructor may be working from. In the unit on coordinate geometry I wanted to cover the basic material and do it as rapidly as possible.

"I don't believe all the thought process objectives are applicable to every situation. Those I used seemed to be quite recognizable in the manner in which I wrote the unit. I do think, if the unit would have been written from a discovery approach, more of the thought process objectives could have been used. The unit then would have been much longer. I do feel the objectives listed are useable, but their use depends on the instructor's approach to the material. I believe it would be difficult to evaluate several of the objectives unless done on an individual basis. For example I-A and II-B.

"I found the thought process objectives quite useful in breaking a problem or concept into its logical parts and in organizing the behavioral objectives to follow a logical sequence. Some may argue that it would take too much time to use the thought process objectives, but in writing a unipac you must have a certain amount of time available and the application of the thought process objectives does not require that much time. It does give you a two-fold approach to writing your objectives for: (1) the desired terminal behavior of the student, and (2) the desired practice of a thought process needed in problem solving.

"I believe the thought process objectives we have worked with this past year will always be directly or indirectly used in my preparation for the classroom. I do feel they have special importance for the unipac writer or anyone who is using behavioral objectives. I don't believe it is enough for just the teacher to be aware of the thought process objectives, but they should also be brought to the student.

"As far as Criterion IV (Was the student able to achieve the objective?), I found the students did an excellent job on the evaluation of the unit. I believe this was partly due to: (1) testing only for the objectives listed, and (2) writing them in thought process form. Number two was especially effective because it broke the problem down into its logical parts. The students not only did well on the evaluation, but they completed the unit pretty much on their own."

Teacher D - Biology.

This teacher summarized his evaluation as follows:

"1. Criterion I.

I believe that the eight major activities I listed in my outline (in a semi-objective form) show that the thought process objectives can relate to the subject matter being tuahgt. I think this is easier in science than in some other areas.

"2. Criterion II.

The activities listed were all planned for small group activities, usually two or three in a group, so each student had to be a full time participant. Each activity has been or is being carried out by each group in the classes.

"3. Criterion III.

Each objective is being tested for as we go along and will be double checked at the end on a spot check basis. Three methods of evaluation are being used, oral (individual) testing, Lab practicals, and essay questions.

"4. Criterion IV.

In the testing done so far I am very pleased that Criterion number four, "The ability of the students to achieve the objectives," is above my expectations. My students (in the two classes involved with the Thought Process Objectives) are all average or above average students in an elective, second year Biology class. This, I suppose, is more like an ideal class for this type of project and would not necessarily be typical of a heterogeneous group of students in a required course. It really is working for these classes.

"5. Final Evaluation.

The test at the end of this unit indicated that the students learned more than the average class in the same subject matter in past years. Whether we spent more class time or whether I was better prepared, I really couldn't determine but I was pleased with the results. The using of the Thought Process Objectives takes much more time in preparation but I feel it is worth the effort. It actually makes class more interesting for the teacher and, I believe, much more interesting for the students. Now, at the end of the year, I am just getting so I can use the thought processes without losing sight of my primary objectives. Earlier in the year I found it hard to do this even though I was trying to work with only a few objectives."

Teacher E - Math

This teacher was able to show in the log kept that he could write the objectives for the lessons in terms of the Thought Process Objectives (Criterion I) and he developed activities for each of the objectives (Criterion II). He did not indicate how he tested for the objectives (Criterion III).

In most instances this was almost self evident. Generally it appeared less troublesome to design evaluation items in mathematics than in some of the other subjects. Also, most of the activities were designed so that it was evident to the teacher whether or not the students were able to perform the objective. The teacher made general statements about the successes and failures the students had in reaching the objectives (Criterion IV) which were generally very positive, but it was not evident whether these conclusions were based on rather objective testing or simply on casual classroom observation.

Teacher F - Chemistry

This teacher had written a very complete set of five unipacs that he used during the evaluation period. All objectives for unipacs are written in behavioral terms and he was able to transfer those which fit the cognitive domain beyond memory to the Thought Process Objectives (Criterion I). The unipacs describe the activities very thoroughly and he was able to show how the activity followed from the Thought Process Objectives. He indicated how he evaluated the students' progress for each objective (Criterion III) but made only general statements about the class success with the objective (Criterion IV).

Teacher G - English

This teacher did not teach lessons in what we think of as the common way during the evaluation period. He made contracts as he indicated in the following instructions to the students.

> "Pick your topic (from this list or any other of interest) -- draw up a contract of what you intend to cover (do), the grade you intend to work for and what you hope to gain from it.
>
> "Each contract will involve a conference with the instructor and a form of presentation to the class. Time allowed for the contract will vary depending on the topics. Allow room on each contract for my comments and suggested references. Contracts must be in dark pencil. (For thermofax copies)
>
> Films -- criticism, making, reports, discussion.
> Literature - self improvement reading list, poetry, prose, drama, satire, short stories.
> Music -
> Small Group Literature Discussions -
> Politics -
> Contemporary Problems -
> Logic -
> Ethics -
> Drama/Speech Presentations -
> Discussion Group and Panels -
> Contemporary Prose/Poetry -
> Science Fiction -
> Philosophy -
> Psychology -
> Mass Media -
> Journalism -
> Experimental Education -
> Contemporary Criticism -
> Black Literature -
> Theatre of Involvement -
> Escapist Literature -
> Mythology -

Political Propaganda -
Creative Writing -
Vocabulary -
Spelling -
Lyrics (pop music) -
Grammar -
Composition - "

It turned out that the twenty students picked out 82 separate contracts.

He explained how he incorporated the use of the objectives with the following statement:

> "First, let me clarify by expressing the belief that almost all objectives were utilized inherently within almost every contract. Projects of this type are based upon careful research, thought and reasoning. Therefore, they can be broken into four areas of effort: reasearch or assimilation; sorting, weighing and valuing; ordering and structuring, and formulation of end product; the proving of hypotheses or the drawing of valid conclusions. Obviously, these four areas are identical to our process objective lists."

It was obvious from the explanation that the students were practicing and learning the Thought Process Objectives but each student was doing a different project and each was working on different objectives at different times. This type of activity does not lend itself to the system accounting of accounting demanded by the four criteria. This teacher though did relate each of the Thought Process Objectives to the four criteria, showing ways in which the criteria were met during the term of the contract assignments.

Teacher H - English.

This teacher was able to show that he could write the objectives during the evaluation period in terms of the Thought Process Objectives (Criterion I). He was not explicit in relating specific objectives to individual activities (Criterion II) and comments on Criteria three and four were too general to help in determining the merits or demerits of any of the objectives.

The summarizations of the eight teacher consultants generally show that they were able to satisfy criteria one and two very well, but some of the teachers indicated less than satisfactory answers to questions prompted by criteria three and four. There is an explanation for this. There is a limit to how far one can manifest by activity realization of a rather abstract concept in such a short time. This writer is still amazed at the transformation that the eight consultants and he himself were able to make in thinking and using Thought Process Objectives (Criteria I and II) in relatively little time and thus feel encouraged by this rather than discouraged because of the greater difficulty in meeting criteria three and four. Also, some teachers <u>were</u> able to meet criteria three and four.

The information received by the teachers in the logs does not provide data that supports making changes in any of the Thought Process Objectives presented in the draft used for evaluation. As Table II indicated, all the objectives were used. The logs indicate that all the objectives that they wished to teach beyond memory could be written in terms of the Thought Process Objectives. Activities were written that gave the students practice in each of the activities. Some teachers were able to indicate how they evaluated the students on the objectives.

The teachers' side comments did not show any indication of inappriateness for any of the objectives and no one indicated that they knew of thought processes that were not included on the list.

Thus the information provided by the early trial periods and the evaluation periods indicate that the list should not be changed further at this time.

It does seem necessary to make a slight rearrangement of the objectives in IV - Integration in order to maintain the hierarchal concept.

Objective IV-F, uses the knowledge of I-B and I-C when put together as a principle, proportioned relationship or formula to obtain a quantitative result, should follow objective IV-B and thus be renumbered IV-C and each objective after the newly numbered IV-C should accordingly be moved one letter of the alphabet.

The final draft then resulting from the data determined by this study is given below:

Thought Process Objectives

I. Assimilation (collecting information). Observes present environment and memory.

   A. Makes observations using all possible resources.

      1. Observes the facts about material things with all the appropriate senses.
         a. Eyes - observes color, illumination, shape, texture, relative placement, and movement.
         b. Ears - observes the quality of sounds: pitch, harmony, rhythm intensity, direction, and the continuance or intermittence of the sound.
         c. Nose - observes the odors.
         d. Tongue - observes the tastes.
         e. Sense of Touch - observes shape, texture, hardness, temperature, and placement.

   B. Observes the interrelatedness of facts in terms of time and space.

C. Observes the changes which occur in the facts when tested and treated by time or other treatments.

D. Views only the facts as observations. When observing does not consider his assumptions or inferences as observations.

II. Process.

A. Retains important and discards the unimportant facts.

B. Keeps facts objective and does not mentally alter them with his own pre-conception, bias or emotion.

C. Is able to note which aspects of communications by others are facts and which are opinions, assumptions, hypothesis.

D. Records data in some form when appropriate.

E. Restructures any communication. Converts from one form to another form and retains the original meaning.

III. Differentiation.

A. Notes differences and likenesses in things, concepts or ideas.

B. Orders things, concepts, ideas according to some criteria such as size, shape, priority and complexity.

C. Sorts according to likenesses and differences using a have and have not dichotomous system.

IV. Integration.

A. Determines trends in data and predicts behaviors and phenomena on the basis of past observed occurences in similar circumstances.

B. Accepts something as a cause of another thing only after having more evidence than the mere fact that the one occurs before the other.

C. Uses the knowledge of I-B and I-C when put together as a principle, proportioned relationship or formula to obtain a quantitative result.

D. Suggests to himself a wide variety of solutions.

E. Makes a final conclusion only after having enough evidence to:

1. Test it mentally, and

2. Test it by trial, if appropriate.

F. Persists in findings when they have been carefully checked, even though they are unpopular.

CHAPTER V

CONCLUSIONS AND RECOMMENDATIONS

In Chapter II of this report this researcher presented what he believes to be a need and a most rational argument for attempting to meet the need. At the present time we are over emphasizing subject matter content in the schools and under emphasizing the ability to use this content to think rationally and productively. This imbalance exists and continues to exist because thinking rationally and productively has not been defined in terms that teachers are able to relate to the classroom. Thinking seems to have no definite beginning or end. It has remained nebulous and thus has been taught nebulously if at all.

This writer still believes this to be so. In fact the data of the last chapter supports the conclusion that, if a structure is provided for the teachers embodying what man does in the process of thinking, the teachers will be able to teach these processes directly and purposefully rather than hapazardly and somewhat incidentally.

But the study brought to the surface another variable that appears to be a significant factor in causing the imbalance between content and process. Now it seems that it should have been obvious before beginning the research. It wasn't of course, but it appeared with the force of such sudden insight that it will never be forgotten in the future.

During the early trials the researcher became increasingly concerned that some of the consultants were not able to write lessons that could be carried off inductively, that motivated the students to accept the responsibility for solving a problem. Therefore the researcher wrote a lesson himself attempting this. His experience is such that there was no difficulty in producing the lesson when a topic in a particular content was established, but he found that he had to write what he thought would cause the students to think and after finishing the lesson went back through it to determine what the actual Thought Proces Objectives were that the lesson incorporated. Even though he believed firmly in the need for teaching Thought Process Objectives he was not able to lay out certain of these objectives and build a lesson from them.

The researcher had discussed the two options with the consultants early in the research year. He told the consultants that they could each write a lesson that they believed incorporated cognition on the part of the students and then go back over the specific lesson and determine what the individual processes were so that they could identify what specific Thought Process Objectives they were teaching. The second option that he explained was to pick out certain Thought Process Objectives and develop activities for teaching them. This he thought would be possible after they had used the process list long enough to understand it well.

The teachers were never able to follow the later option. Neither was the researcher. This writer can only conclude that we all are so conditioned to a world of time, places and things that we are not able to think in terms of mental processes. We have all been taught content. How we think has been left to the incidental. Thus we as teachers are not able to retool our minds to think in any other way in a short time. We can only think in terms of teaching facts and simple operation skills.

This is not to suggest that we should teach process that is void of content. This, of course, is impossible. But the writer does suggest that if we are going to zero in on certain acts of the mental process in teaching, then we must learn to pick the processes out as objectives and build a lesson on these processes. This should be done in all the subject matter areas that we accept now in the elementary and secondary schools. The thought processes exist and can be taught directly but we are not ready to teach them. Unless some rather vast retooling of the present system be carried out it will be a long time before we are.

The above conclusion has a direct bearing on the nature of the recommendations this writer would make about the continuance of research on the Thought Process Objectives. First, it would seem necessary for others who can accept the premise for the need and the cause of the existing need as written here to attempt to devise a list independent of this one in method and content. This writer did lean heavily on parameters layed out by John Dewey. These parameters have found wide acceptance and probably were even the basis for the steps of the so called scientific method that was relied on extensively a couple decades ago. It seems important that we continue to find better models for describing the abstraction we refer to as thought process.

This researcher would like to also suggest that this list be further used and developed following this procedure:

1. A large group of secondary teachers be selected on the following criteria:

   a. Open to change.
   b. Creative.
   c. Interested in teaching inquiry, discovery, critical thinking, etc.

2. This group be taught some subject using the Thought Process Objectives as they in turn will teach their own high school students.

3. This group study the Thought Process Objectives, write lessons incorporating it, peer teach, criticize.

4. The group, through the efforts of the coordinator, modify the list.

5. Select those who wish to continue.

6. The selected group will teach, using the Process list, for one school year. During this year they will:

   a. Be visited weekly.
   b. Hold group meetings twice monthly.
   c. Visit each other's classes at least monthly.

7. At the end of the school term, a selected group from the main group will:

   a. Revise the list.
   b. Write sample lessons.
   c. Write sample tests.

This researcher realized soon after the past school year began that a few meetings in the fall were not enough along with the practice trial periods to develop the teachers' complete acceptance of the list and train them in the use of it. Thus he suggests that the training and writing period be carried out for the entire summer before the trial year begins.

Also, the follow up, the collecting of data and final revisions of the list should incorporate more of the effort of the people working during the trial year.

After completion of this second project, the list and sample lessons should be ready for introduction into major teacher education systems in the country on both the undergraduate and graduate levels.

Two important groups are asking the public school teachers for accountability. These are top government officials and the secondary students of the country. The high school students in particular are asking that the teachers give them practice in thinking and creating rather than merely treat them as passive recipients of facts. David Page[7] said it this way in 1849:

> "A passive recipient is a two-gallon jug. Whenever the teacher does not first excite inquiry, first prepare the mind by waking it up to desire to know, and if possible to find out by itself, but proceeds to think for the child, and to give him the results, before they are desired, or before they have been sought for, he makes the mind of the child a two-gallon jug, into which he may pour just two gallons, but no more. And if day after day he should continue to pour in, day after day he may expect that what pours in will run all over."

It is more than reasonable that at least some of the unrest in the secondary schools is stimulated by students holding their teachers accountable to what is being taught. Many students feel that they are being channeled into a single way of being by obedience to old truths and regulations rather than being prepared to creatively find new answers to old questions.

The old security of teaching the facts of a textbook is thankfully becoming less secure, but teachers need help in retooling their own minds so that they can guide their young charges to become divergent and self respecting creative thinkers. This help can come in the form of a structure that defines divergent thinking in the language of the teacher. It is for this reason that this writer believes that the study of the creation and use of Thought Process Objectives must continue.

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